

# Management Measures Quick Reference Guide

## Background

Degradation of water resources from nonpoint source (NPS) pollution is considered to be the leading cause of water quality impairments both nationally and in California. Most NPS problems are related to land use practices. In California, numerous State, federal and local agencies, as well as landowners and non-governmental organizations (NGOs), are involved with efforts to prevent or control NPS pollution. These efforts are often supported by and coordinated through California's NPS Program under the State Water Resources Control Board (SWRCB) and Regional Water Quality Control Boards (RWQCBs), and through the California Coastal Commission's (CCC) Coastal Nonpoint Pollution Control Program. The goals of current efforts are to upgrade the State's NPS Management Plan consistent with the guidance of the U.S. Environmental Protection Agency (USEPA),<sup>1</sup> and to ensure that the Plan effectively addresses nonpoint sources affecting coastal waters as required by Section 6217 of the 1990 Coastal Zone Act Reauthorization Amendments (CZARA).

## Implementation of Management Measures

CZARA requires coastal states to develop and implement management measures for NPS pollution to restore and protect coastal waters.<sup>2</sup> The management measure approach is technology-based rather than water-quality-based. The management measures are organized into six categories or "sectors":

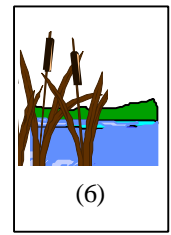
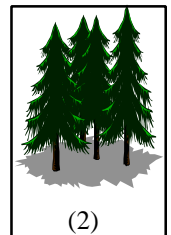
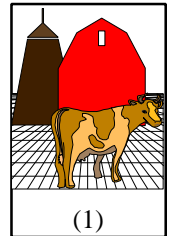
- (1) Agriculture;
- (2) Forestry (Silviculture);
- (3) Urban Areas;
- (4) Marinas and Recreational Boating;
- (5) Hydromodification Activities; and
- (6) Wetlands, Riparian Areas, and Vegetated Treatment Systems.

All six categories are present in California.

<sup>1</sup> California's NPS Program was established more than ten years ago in response to the requirements of federal Clean Water Act § 319(h). The federal Clean Water Action Plan calls on all states to upgrade their NPS Programs in order to be eligible for additional funding in federal fiscal year 2000 and beyond.

<sup>2</sup> Management measures are defined in CZARA § 6217(g)(5) as "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives." The USEPA § 6217(g)-Guidance lists 56 management measures to control or prevent NPS pollution affecting coastal waters (these measures can be viewed at <http://www.epa.gov/OWOW/NPS/MMGI>).

## Fact Sheets



The management measures form the core of the State's upgraded NPS Management Plan, and provide goals to which various management practices are applied. The SWRCB, CCC and other State agencies are developing a *Management Measure Review Document* that delineates each management measure as applicable in California. The original CZARA § 6217(g) management measure language has been retained for nearly all of the management measures. California has modified the management measure language only slightly; in almost all cases the modifications have made the management measures more protective of the environment. The SWRCB, CCC and each of the Regional Water Quality Control Boards evaluated each management measure. In addition, each state agency that was designated in the document evaluated the management measures for appropriateness for California. California has included an additional management measure for education and outreach to each nonpoint source category to reflect the State's intention to promote public awareness and involvement in controlling nonpoint source pollution. This brings the total number of management measures in California to 60. Background information on these management measures is provided in the attached Fact Sheets.

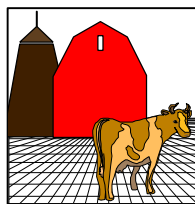
Not all of the identified management measures may be needed to address the nonpoint sources at a specific site. For example, forestry and construction operations that do not use chemicals would not need to implement chemical-control management measures. Similarly, farms or other agriculture enterprises that do not have animals as part of the enterprise would not need to implement the management measures that address confined animal facilities or grazing. Other operations will have more than one source to address and may need to employ two or more measures to address the multiple sources. Application of the measures should be coordinated to produce an overall system that adequately addresses all sources for the site in a cost-effective manner.

Many operations may already be in compliance with the measures needed to address the nonpoint sources associated with them. Existing NPS progress will be recognized and appropriate credit given for a practice that is in existence and operational. Existing practices, plans, and systems should be viewed as building blocks for the management measures and may need no additional improvement. For cases where existing source control is inadequate to achieve conformity with the needed management measures, only one or two more practices may need to be added to achieve conformity.

Finding solutions to NPS pollution poses unique challenges. While increased use of existing regulatory authorities can help to address certain categories of NPS pollution (such as the relatively recent effort to issue permits for the most significant municipal stormwater discharges), California will need to rely on a wide range of tools, activities, and authorities to effectively address NPS pollution statewide. In particular, these efforts need to focus on better integration and coordination at the State level and collaborative approaches to establish ongoing community-based stewardship.

## NPS/CZARA FACT SHEET No. 1

### Agriculture Management Measures



The SWRCB, CCC, and other State agencies have identified seven management measures (MMs) to address agricultural nonpoint sources of pollution that affect State waters. The agricultural MMs include practices and plans installed under various NPS programs in California, including systems of

practices commonly used and recommended by the U.S. Department of Agriculture (USDA) as components of Resource Management Systems, Water Quality Management Plans and Agricultural Waste Management Systems.

According to the USEPA (1993), agriculture contributes more than half of the pollution entering the Nation's waterbodies; recent studies have identified it as the greatest source of water pollution in the United States. The primary agricultural NPS pollutants are nutrients, sediment, animal wastes, pesticides, and salts. Agricultural activities may also affect habitat through physical disturbances caused by livestock or equipment, or through the management of water.

#### **NPS/CZARA management measures to address agricultural sources of nonpoint pollution in California:**

- 1A. Erosion and Sediment Control**
- 1B. Facility Wastewater and Runoff from Confined Animal Facilities**
- 1C. Nutrient Management**
- 1D. Pesticide Management**
- 1E. Grazing Management**
- 1F. Irrigation Water Management**
- 1G. Education/Outreach**

#### **Management Measures:**

**Erosion and Sediment Control.** MM 1A addresses NPS problems associated with soil erosion and sedimentation. Where erosion and sedimentation from agricultural lands affects coastal waters, landowners shall design and install a combination of practices to remove solids and associated pollutants in runoff during all but the larger storms. Alternatively, landowners may apply the erosion component of a Conservation Management System (CMS) as defined in the USDA Field Office Technical Guide.

**Facility Wastewater and Runoff from Confined Animal Facilities.** Pursuant to MM 1B, facility wastewater and contaminated runoff from confined animal facilities must be contained at all times. Storage facilities should be of adequate capacity to allow for proper waste water use and should be constructed so they prevent seepage to ground water, and stored runoff and accumulated solids from the facility shall be managed through a waste use system that is consistent with MM 1C.

**Nutrient Management.** MM 1C addresses the development and implementation of comprehensive nutrient management plans for areas where nutrient runoff is a problem affecting coastal waters. Such plans would include a crop nutrient budget; identification of the types, amounts and timing of nutrients necessary to produce a crop based on realistic crop yield expectations; identification of hazards to the site and adjacent environment; soil sampling and tests to determine

crop nutrient needs; and proper calibration of nutrient equipment. When manure from confined animal facilities is to be used as a soil amendment and/or is disposed of on land, the plan shall discuss steps to assure that subsequent irrigation of that land does not leach excess nutrients to surface or ground water.

**Pesticide Management.** Implementation of MM 1D is intended to reduce contamination of surface water and ground water from pesticides. Elements of this measure include reductions in pesticide use; evaluation of pest, crop and field factors; use of Integrated Pest Management (IPM); consideration of environmental impacts in choice of pesticides; calibration of equipment; and use of anti-backflow devices. IPM is a key component of pest control. IPM strategies include evaluating pest problems in relation to cropping history and previous pest control measures, and applying pesticides only when an economic benefit will be achieved. Pesticides should be selected based on their effectiveness to control target pests and environmental impacts such as their persistence, toxicity, and leaching potential.

**Grazing Management.** MM 1E is intended to protect sensitive areas (including streambanks, lakes, wetlands, estuaries, and riparian zones) by reducing direct loadings of animal wastes and sediment. Upland erosion can be reduced by, among other methods: (1) maintaining the land consistent with the California Rangeland Water Quality Management Plan or Bureau of Land Management and Forest Service activity plans or (2) applying the range and pasture components of a Conservation Management System. This may include restricting livestock from sensitive areas by providing livestock stream crossings and by locating salt, shade, and alternative drinking sources away from sensitive areas.

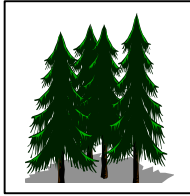
**Irrigation Water Management.** MM 1F promotes effective irrigation while reducing pollutant delivery to surface and ground waters. Pursuant to this measure, irrigation water would be applied uniformly based on an accurate measurement of cropwater needs and the volume of irrigation water applied, considering limitations raised by such issues as water rights, pollutant concentrations, water delivery restrictions, salt control, wetland, water supply and frost/freezing temperature management. Additional precautions would apply when chemicals are applied through irrigation.

**Education/Outreach.** The goals of MM 1G are to implement pollution prevention and education programs to reduce NPS pollutants generated from the following activities where applicable:

- a. Activities that cause erosion and loss of sediment on agricultural land and land that is converted from other land uses to agricultural land;
- b. Activities that cause discharge from confined animal facilities to surface waters;
- c. Activities that cause excess delivery of nutrients and/or leaching of nutrients;
- d. Activities that cause contamination of surface water and ground water from pesticides;
- e. Grazing activities that cause physical disturbance to sensitive areas and the discharge of sediment, animal waste, nutrients, and chemicals to surface waters;
- f. Irrigation activities that cause NPS pollution of surface waters.

## NPS/CZARA FACT SHEET No. 2

### Forestry (Silviculture) Management Measures



The SWRCB, CCC, and other State agencies have identified 12 management measures (MMs) to address various phases of forestry operations relevant to controlling nonpoint sources of pollution that affect State waters. The forestry MMs are

for the most part a system of practices used and recommended by the Board of Forestry and Department of Forestry and Fire Protection in rules or guidance.

On a national level, silviculture contributes approximately 3 to 9% of NPS pollution to the Nation's waters (USEPA, 1992a). Without adequate controls, forestry operations may degrade the characteristics of waters that receive drainage from forest lands. For example (1) sediment concentrations can increase due to accelerated erosion, (2) water temperatures can increase due to removal of overstory riparian shade, (3) dissolved oxygen can be depleted due to the accumulation of slash and other organic debris, and (4) concentrations of organic and inorganic chemicals can increase due to harvesting and fertilizers and pesticides.

#### California's management measures to address silvicultural sources of nonpoint pollution:

- 2A. Preharvest Planning
- 2B. Streamside Management Areas
- 2C. Road Construction/Reconstruction
- 2D. Road Management
- 2E. Timber Harvesting
- 2F. Site Preparation/Forest Regeneration
- 2G. Fire Management
- 2H. Revegetation of Disturbed Areas
- 2I. Forest Chemical Management
- 2J. Wetlands Forest
- 2K. Education/Outreach
- 2L. Postharvest Evaluation

#### Management Measures:

**Preharvest Planning.** Pursuant to MM 2A, silvicultural activities shall be planned to reduce potential delivery of pollutants to surface waters. Components of MM 2A address aspects of forestry operations, including: the timing, location and design of harvesting and road construction; site preparation; identification of sensitive or high-erosion risk areas; and the potential for cumulative water quality impacts.

**Streamside Management Areas (SMAs).** SMAs protect against soil disturbance and reduce sediment and nutrient delivery to waters from upland activities. MM 2B is intended to safeguard vegetated buffer areas along surface waters to protect the water quality of adjacent streams.

**Road Construction/Reconstruction.** Pursuant to MM 2C, road construction/reconstruction shall be conducted so as to reduce sediment generation and delivery. This can be accomplished by, among other means, following preharvest plan layouts and designs for road systems, incorporating adequate drainage structures, properly installing stream crossings, avoiding road construction in SMAs, removing debris from streams, and stabilizing areas of disturbed soil such as road fills.

**Road Management.** MM 2D describes how to manage roads to prevent sedimentation, minimize erosion, maintain stability, and reduce the risk that drainage structures and stream crossings will fail or become less effective. Components of this measure include inspections and maintenance actions to prevent erosion of road surfaces and to ensure the effectiveness of stream-crossing structures. The measure also addresses appropriate methods for closing roads that are no longer in use.

**Timber Harvesting.** MM 2E addresses skidtrail location and drainage, management of debris and petroleum, and proper harvesting in SMAs. Timber harvesting practices that protect water quality and soil productivity also have economic benefits by reducing the length of roads and skidtrails, reducing equipment and road maintenance costs, and providing better road protection.

**Site Preparation & Forest Regeneration.** Impacts of mechanical site preparation and regeneration operations—particularly in areas that have steep slopes or highly erodible soils, or where the site is located in close proximity to a waterbody—can be reduced by confining runoff onsite. MM 2F addresses keeping slash material out of drainageways, operating machinery on contours, timing of activities, and protecting ground cover in ephemeral drainage areas and SMAs. Careful regeneration of harvested forest lands is important in protecting water quality from disturbed soils.

**Fire Management.** Prescribed fire practices for site preparation and methods to suppress wildfires should as feasible be conducted in a manner that limits loss of soil organic matter and litter and that reduces the potential for runoff and erosion. Prescribed fires on steep slopes or adjacent to streams and that remove forest litter down to mineral soil are most likely to impact water quality.

**Revegetation of Disturbed Areas.** MM 2H addresses the rapid revegetation of areas disturbed during timber harvesting and road construction—particularly areas within harvest units or road systems where mineral soil is exposed or agitated (e.g., road cuts, fill slopes, landing surfaces, cable corridors, or skidtrails) with special priority for SMAs and steep slopes near drainageways.

**Forest Chemical Management.** Application of pesticides, fertilizers, and other chemicals used in forest management should not lead to surface water contamination. Pesticides must be properly mixed, transported, loaded, and applied, and their containers disposed of properly. Fertilizers must also be properly handled and applied since they also may be toxic depending on concentration and exposure. Components of MM 2I include applications by skilled workers according to label instructions, careful prescription of the type and amount of chemical to be applied, use of buffer areas for surface waters to prevent direct application or deposition, and spill contingency planning.

**Wetland Forest Management.** Forested wetlands provide many beneficial water quality functions and provide habitat for aquatic life. Activities in wetland forests shall be conducted to protect the aquatic functions of forested wetlands.

**Education/Outreach.** The goals of MM 2K are to implement pollution prevention and education programs to reduce NPS pollutants generated from applicable silvicultural activities.

**Postharvest Evaluation.** The goals of MM 2L are to incorporate postharvest monitoring, including: a) implementation monitoring to determine if the operation was conducted according to specifications, and b) effectiveness monitoring after at least one winter period to determine if the specified operation prevented or minimized discharges.

## NPS/CZARA FACT SHEET No. 3

### Urban Management Measures



The SWRCB, CCC, and other State agencies have identified 15 management measures (MMs) to address urban nonpoint sources of pollution that affect State waters. With approximately 80% of the nation's population living in coastal areas, controlling polluted runoff in urban areas is a challenge. Negative impacts of urbanization on coastal and estuarine waters are well documented in a number of sources, including California's Clean Water Act §305(b) and §319 reports and the Nationwide Urban Runoff Program.

Major pollutants found in runoff from urban areas include sediment, nutrients, oxygen-demanding substances, road salts, heavy metals, petroleum hydrocarbons, pathogenic bacteria, and viruses. Suspended sediments constitute the largest mass of pollutant loadings to receiving waters from urban areas. Construction is a major source of sediment erosion. Petroleum hydrocarbons result mostly from automobile sources. Nutrient and bacterial sources include garden fertilizers, leaves, grass clippings, pet wastes, and faulty septic tanks. As population densities increase, a corresponding increase occurs in pollutant loadings generated from human activities. Many of these pollutants enter surface waters via runoff without undergoing treatment.

#### **California's management measures to address urban sources of nonpoint pollution:**

##### **3.1 Runoff from Developing Areas**

- A. Watershed Protection
- B. Site Development
- C. New Development

##### **3.2 Runoff from Construction Sites**

- A. Construction Site Erosion and Sediment Control
- B. Construction Site Chemical Control

##### **3.3 Runoff from Existing Development**

- A. Existing Development

##### **3.4 Onsite Disposal Systems (OSDSs)**

- A. New OSDSs
- B. Operating OSDSs

##### **3.5 Transportation Development (Roads, Highways, and Bridges)**

- A. Planning, Siting, and Developing Roads and Highways
- B. Bridges
- C. Construction Projects
- D. Chemical Control
- E. Operation and Maintenance
- F. Road, Highway, and Bridge Runoff Systems

##### **3.6 Education/Outreach**

- A. Pollution Prevention/Education: General Sources

Urban runoff management requires that several objectives be pursued simultaneously. These objectives include the following (American Public Works Association, 1981):

- Protection and restoration of surface waters by the minimization of pollutant loadings and negative impacts resulting from urbanization;
- Protection of environmental quality and social well-being;
- Protection of natural resources, e.g., wetlands and other important aquatic and terrestrial ecosystems;

- Minimization of soil erosion and sedimentation problems;
- Maintenance of the predevelopment hydrologic conditions;
- Protection of ground-water resources;
- Control and management of runoff to reduce or prevent flooding; and
- Management of aquatic and riparian resources for active and passive.

### **Management Measures:**

The control of urban NPS pollution requires the use of two primary strategies: the prevention of pollutant loadings and the treatment of unavoidable loadings. California's urban management measures are organized to parallel the land use development process in order to address the prevention and treatment of NPS pollution loadings during all phases of urbanization; this strategy relies primarily on the watershed approach, which focuses on pollution prevention or source reduction practices. A combination of pollution prevention and treatment practices is favored because planning, design, and education practices are generally more effective, require less maintenance, and are more cost-effective in the long term.

The major opportunities to control NPS loadings occur during the following three stages of development: (1) the siting and design phase, (2) the construction phase, and (3) the post-development phase. Before development occurs, land in a watershed is available for a number of pollution prevention and treatment options, such as setbacks, buffers, or open space requirements, as well as wet ponds or constructed urban runoff wetlands that can provide treatment of the inevitable runoff and associated pollutants. In addition, siting requirements and restrictions and other land use ordinances, which can be highly effective, are more easily implemented during this period. After development occurs, these options may no longer be practicable or cost-effective. MMs 3.1A through 3.1C address the strategies and practices that can be used during the initial phase of the urbanization process.

The control of construction-related sediment loadings is critical to maintaining water quality. The implementation of proper erosion and sediment control practices during the construction stage can significantly reduce sediment loadings to surface waters. MMs 3.2A and 3.2B address construction-related practices.

After development has occurred, lack of available land severely limits the implementation of cost-effective treatment options. MM 3.6A focuses on improving controls for existing surface water runoff through pollution prevention to mitigate nonpoint sources of pollution generated from ongoing domestic and commercial activities.



**NPS/CZARA FACT SHEET No. 4****Marinas & Recreational Boating Management Measures**

The SWRCB, CCC, and other State agencies have identified 17 management measures (MMs) to address marina and recreational boating sources of nonpoint pollution that affect State waters. Because marinas are located at the water's edge, pollutants generated from marinas and boats are less likely to be buffered or filtered by natural processes and are thus more likely to adversely affect coastal waters and resources. When boating and boating-related activities (e.g., marinas and maintenance areas) are poorly planned or managed, they may threaten the health of aquatic systems and pose other environmental hazards. The USEPA (1993) identifies several sources of pollution associated with marinas and boating activities:

- Poorly flushed waterways;
- Pollutants discharged from boats (recreational boats, commercial boats, and "live-aboards");
- Pollutants carried in stormwater runoff from impervious surfaces (parking lots, roofs, etc.);
- Physical alteration of wetlands and of shellfish/other benthic communities during construction of marinas, ramps, and related facilities;
- Pollutants generated from boat maintenance activities on land and in the water.

**California's management measures to address marina and boating sources of nonpoint pollution:**
**4.1 Assessment, Siting and Design**

- A. Water Quality Assessment
- B. Marina Flushing
- C. Habitat Assessment
- D. Shoreline Stabilization
- E. Stormwater Runoff
- F. Fueling Station Design
- G. Sewage Facilities
- H. Waste Management Facilities

**4.2 Operation and Maintenance**

- A. Solid Waste Control
- B. Fish Waste Control
- C. Liquid Material Control
- D. Petroleum Control
- E. Boat Cleaning and Maintenance
- F. Maintenance of Sewage Facilities
- G. Boat Operation

**4.3 Education/Outreach**

- A. Public Education

**Management Measures:**

California's management measures are intended to be applied to control impacts to water quality and habitat from marina siting and construction (both new and expanding marinas), and marina and boat operation and maintenance. The measures are designed to reduce nonpoint source (NPS) pollution by requiring the best possible siting for marinas and hull maintenance areas, providing for the best available design and construction practices and for appropriate operation and maintenance practices, and encouraging the development and use of effective pollution control and education efforts. The following operations/facilities are covered by the management measures (USEPA, 1993):

- Any facility that contains 10 or more slips, piers where 10 or more boats may tie up, or any facility where a boat for hire is docked;

- Boat maintenance or repair yards that are adjacent to the water;
- Any Federal, State, or local facility that involves recreational boat maintenance or repair that is on or adjacent to the water;
- Public or commercial boat ramps;
- Any residential or planned community marina with 10 or more slips; and
- Any mooring field where 10 or more boats are moored.

**Siting and Design.** Siting and design are among the most significant factors influencing the long-term impact a marina will have on water quality within the immediate vicinity of the marina and the adjacent waterway. Initial marina site selection is the most important factor. The location of a marina—e.g., its basin configuration [whether it is open (located directly on a bay or river) or semi-enclosed] and its orientation to prevailing winds—influence circulation and flushing, which in turn play important roles in the distribution and dilution of potential contaminants. Thus the selection of a site that has favorable hydrographic characteristics and that requires the least amount of modification can reduce potential impacts. Because marina development can result in reduced levels of dissolved oxygen, many waters with average dissolved oxygen concentrations barely at or below State standards may be unsuitable for marina development. The final design of a marina is usually a compromise that will provide the most desirable combination of marina capacity, services, and access, while minimizing environmental impacts, dredging requirements, protective structures, and other site development costs. For those planning to build a marina, attention to the environmental concerns of marina operation during the marina design phase will significantly reduce the potential for generating pollution from these activities. The objective of the Marina Assessment, Siting and Design MMs is to ensure that marinas and ancillary structures do not cause direct or indirect adverse water quality impacts or endanger fish, shellfish, and wildlife habitat before, during and following marina construction.

**Operation and Maintenance.** During the course of normal marina operations, various activities and locations in the marina can generate polluting substances. Such activities include waste disposal, boat fueling, and boat maintenance and cleaning; such locations include storage areas for materials required for these activities and hull maintenance areas. Of special concern are substances that can be toxic to aquatic biota, pose a threat to human health, or degrade water quality. Paint sandings and chippings, oil and grease, fuel, detergents, and sewage are examples. It is important that marina operators and patrons take steps to control or minimize the entry of these substances into marina waters. For the most part, this can be accomplished with simple preventive measures such as performing these activities on protected sites, locating servicing equipment where the risk of spillage is reduced (see the Siting and Design MMs), providing adequate and well-marked disposal facilities, and educating the boating public about the importance of pollution prevention.

**Education/Outreach.** The benefit of effective pollution prevention to the marina operator can be measured as the relative low cost of pollution prevention compared to potentially high environmental clean-up costs. For existing marinas, minor changes in operations, staff training, and boater education should help protect marina waters from these sources of pollution.

## NPS/CZARA FACT SHEET No. 5

### Hydromodification Management Measures



The SWRCB, CCC, and other State agencies have identified eight management measures (MMs) to address hydromodification sources of nonpoint pollution affecting State waters. Hydromodification includes modification of stream and river channels, dams and water impoundments, and streambank/shoreline erosion.

Channel modification activities are undertaken in rivers or streams to straighten, enlarge, deepen or relocate the channel. These activities can affect water temperature, change the natural supply of fresh water to a waterbody, and alter rates and paths of sediment erosion, transport, and deposition. Hardening the banks of waterways with shoreline protection or armor also accelerates the movement of surface water and pollutants from the upper reaches of watersheds into coastal waters. Channelization can also reduce the suitability of instream and streamside habitat for fish and wildlife by depriving wetlands and estuarine shorelines of enriching sediments, affecting the ability of natural systems to filter pollutants, and interrupting the life stages of aquatic organisms (USEPA, 1993).

#### California's management measures to address sources of nonpoint pollution related to hydromodification activities:

##### 5.1 Channelization/Channel Modification

- A. Physical & Chemical Characteristics of Surface Waters
- B. Instream & Riparian Habitat Restoration

##### 5.2 Dams

- A. Erosion & Sediment Control
- B. Chemical & Pollutant Control
- C. Protection of Surface Water Quality & Instream and Riparian Habitat

##### 5.3 Streambank & Shoreline Erosion

- A. Eroding Streambanks & Shorelines

##### 5.4 Education/Outreach

- A. Pollution Prevention/Education
- B. Education/Assistance

Dams can adversely impact hydrology and the quality of surface waters and riparian habitat in the waterways where the dams are located. A variety of impacts can result from the siting, construction, and operation of these facilities. For example, improper siting of dams can inundate both upstream and downstream areas of a waterway. Dams reduce downstream flows, thus depriving wetlands and riparian areas of water. During dam construction, removal of vegetation and disturbance of underlying sediments can increase turbidity and cause excessive sedimentation in the waterway.

The erosion of shorelines and streambanks is a natural process that can have either beneficial or adverse impacts on riparian habitat. Excessively high sediment loads resulting from erosion can smother submerged aquatic vegetation, cover shellfish beds and tidal flats, fill in riffle pools, and contribute to increased levels of turbidity and nutrients.

## **Management Measures:**

**Channelization/Channel Modification.** California's management measures for channelization and channel modification promote the evaluation of channelization and channel modification projects. Channels should be evaluated as a part of the watershed planning and design processes, including watershed changes from new development in urban areas, agricultural drainage, or forest clearing. The purpose of the evaluation is to determine whether resulting NPS changes to surface water quality or instream and riparian habitat can be expected and whether these changes will be good or bad. Existing channelization and channel modification projects can be evaluated to determine the NPS impacts and benefits associated with the projects. Modifications to existing projects, including operation and maintenance or management, can also be evaluated to determine the possibility of improving some or all of the impacts without changing the existing benefits or creating additional problems. In both new and existing channelization and channel modification projects, evaluation of benefits and/or problems will be site-specific.

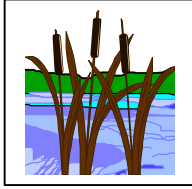
**Dams.** The second category of management measures address NPS pollution associated with dams. Dams are defined as constructed impoundments that are either (1) 25 feet or more in height *and* greater than 15 acre-feet in capacity, or (2) 6 feet or more in height *and* greater than 50 acre-feet in capacity. MMs 5.2A and 5.2B address two problems associated with dam construction: (1) increases in sediment delivery downstream resulting from construction and operation activities and (2) spillage of chemicals and other pollutants to the waterway during construction and operation. MM 5.2C addresses the impacts of reservoir releases on the quality of surface waters and instream and riparian habitat in downstream.

**Streambank and Shoreline Erosion.** The third category of hydromodification measures addresses the stabilization of eroding streambanks and shorelines in areas where streambank and shoreline erosion creates a polluted runoff problem. Bioengineering methods such as marsh creation and vegetative bank stabilization are preferred. Streambank and shoreline features that have the potential to reduce polluted runoff shall be protected from impacts, including erosion and sedimentation resulting from uses of uplands or adjacent surface waters. This MM does not imply that all shoreline and streambank erosion must be controlled; the measure applies to eroding shorelines and streambanks that constitute an NPS problem in surface waters.

**Education/Outreach.** MMs 5.4A and 5.4B focus on the development and implementation of pollution prevention and education programs for agency staffs and the public, as well as the promotion of assistance tools that emphasize restoration and low-impact development. Education, technical assistance, incentives, and other means can be used to promote projects that reduce NPS pollutants, which retain or re-establish natural hydrologic functions (e.g., channel restoration projects and low-impact development projects), and/or which prevent and restore adverse effects of hydromodification activities.

## NPS/CZARA FACT SHEET No. 6

### Wetlands and Riparian Areas Management Measures



The SWRCB, CCC, and other State agencies have identified four management measures (MMs) to promote the protection and restoration of wetlands and riparian areas and the use of vegetated treatment systems as means to control nonpoint sources of pollution. Wetlands and riparian areas reduce polluted runoff by filtering out runoff-related contaminants such as sediment, nitrogen and phosphorus; thus maintaining the water quality benefits of these areas is important. These areas also help to attenuate flows from higher-than-average storm events. This protects downstream areas from adverse impacts such as channel scour, erosion and temperature and chemical fluctuations. Changes in hydrology, substrate, geochemistry, or species composition can impair the ability of wetland or riparian areas to filter out excess sediment and nutrients, and so can result in deteriorated water quality. The following activities can cause such impairment: drainage of wetlands for cropland, overgrazing, hydromodification, highway construction, deposition of dredged material, and excavation for ports and marinas.

**California's management measures to protect and restore wetlands and riparian areas and use vegetated treatment systems as means to control pollution from nonpoint sources:**

**6A. Protection of Wetlands & Riparian Areas**

**6B. Restoration of Wetlands & Riparian Areas**

**6C. Vegetated Treatment Systems**

**6D. Education/Outreach**

#### **Management Measures:**

**Wetlands/Riparian Areas Protection.** Implementation of MM 6A is intended to protect the existing water quality improvement functions of wetlands and riparian areas as a component of NPS programs.

**Wetlands/Riparian Areas Restoration.** Restoration of wetlands and riparian areas (MM 6B) refers to the recovery of a range of functions that existed previously by reestablishing hydrology, vegetation, and structure characteristics. Damaged or destroyed wetland and riparian areas should be restored where restoration of such systems will significantly abate polluted runoff.

**Vegetated Treatment Systems.** MM 6C promotes the installation of vegetated treatment systems (e.g., artificial or constructed wetlands) in areas where these systems will serve a polluted runoff-abatement function. Vegetated filter strips and engineered wetlands remove sediment and other pollutants from runoff and wastewater, and prevent pollutants from entering adjacent waterbodies. Removal typically occurs through filtration, deposition, infiltration, absorption, adsorption, decomposition and volatilization.

**Education/Outreach.** MM 6D promotes the establishment of programs to develop and disseminate scientific information on wetlands and riparian areas and to develop greater public

and agency staff understanding of natural hydrologic systems—including their functions and values, how they are lost, and the choices associated with their protection and restoration.